directed to the attainment of national objects by men whose individual powers have been trained to make effective use of western science, and the results have been simply wonderful.

These results have been most apparent in the operations of war. It was the sound of the cannon on the Yalu River, in the war with China ten years ago, which awoke Europe and America to a knowledge of the fact that a new nation had been born in the Far East, and which at the same time started many of the political problems which have led up to the present war with Russia. That war, whatever its ultimate results may be, has shown that the Japanese have not only been able to take full advantage of the applications of western science, but that they have been animated by the spirit of old Japan, which has made them regardless of personal sacrifices. The Army and Navy have been organised and worked on scientific methods, and with a completeness of arrangements which has won for them the admiration of all impartial critics. Their intense patriotism has caused them to perform deeds of daring which are unequalled in the history of war, while their skill in strategy and in the applications of the latest scientific methods to all they have done has made them almost uniformly successful in their operations. They have demonstrated the importance of the work of the engineer. The railways which have been built in Japan have been fully utilised to convey men and materials, and the ships to transport them oversea. The telegraphs have been used to communicate instructions and to keep the authorities informed regarding movements and requirements. The dockyards and shipbuilding yards have been ready to undertake repairs, and the arsenals and machine shops to turn out war material of all kinds, as well as appliances which aid operations in the field. Light railways have been laid down on the way to battlefields, and wireless telegraphy and telephones to convey instructions to soldiers; in short, all the latest applications of mechanical, electrical, and chemical science have been freely and intelligently employed.

The ships of the Japanese Navy are probably the best illustrations of the Japanese methods of procedure. In naval matters they accepted all the guidance the western world could give them, but at the same time they struck out a line of their own, and the fleet which they have created is unique in the character of its units. British designs have in many respects been improved upon, with the result that they have obtained in their latest ships many features which have won the admiration of the naval world. The inventions and improvements which have been made by Japanese officers, engineers, and scientific men disprove the charge which is very often made, that the Japanese have no originality. Even in the matter of pure science Japanese investigators have shown that they are able to take their places among those who have extended the borders of knowledge. The memoirs and papers published by Japanese students and teachers, both on scientific and literary subjects, will bear very favourable comparison with those of any other country, and while no Japanese Newton, Darwin, or Kelvin has yet arisen, there are men connected with Japanese universities and colleges of whom any learned institution in the world would have no reason to be ashamed.

I must refer to my book for details of the developments which have taken place in engineering and industry. Suffice it to say that roads and rivers have been improved, railways to the extent of between four and five thousand miles have been constructed, a large mercantile marine has been created, docks and harbours have been made, telegraphs and telephones are in use all over the country, excellent postal arrangements are in operation, and there are few departments of mechanical and chemical industry in which there are not many establishments doing very efficient work. The result of it all has been that commerce has been immensely extended, and the financial resources of the country developed in such a manner as to enable Japan to take her place among the powerful nations of the world.

At the root of all these developments has been the very complete system of education which has been established in the country. Elementary schools are to be found in every district, and secondary and technical schools in populous centres, while the universities of Tokyo and Kyoto supply the highest training required for the national life; but for details of these I must again refer to my book. The motive underlying all the efforts is what I wish chiefly to emphasise. Shortly after the Emperor succeeded to the throne, he issued a proclamation which contained the following sentence:—"Knowledge and learning shall be sought after throughout the whole world, *in order that the status of the Empire of Japan may be raised ever higher and higher.*" The recent history of Japan is the most striking illustration of the influence of a wisely directed system of education on national affairs when those who are responsible for it are infused with high national ideals.

At the same time it should be noted that some of the most thoughtful and influential men in Japan doubt whether the official system of education is likely to lead to the best results. They feel, like Matthew Arnold, that too often the machinery and organisation receive more attention than the real education, and, moreover, they dislike the idea of all educational institutions being of the same type. Probably the most influential educationist in Japan was Yukichi Fukuzawa, and he never failed to point out the possible evils which are likely to arise from a too strictly official routine. His own college, the Keio Gijuku, has been a great school for statesmen, lawyers, and public men, and many of the leading men in Japan have been his pupils. Count Okuma, the distinguished statesman, has also established what is essentially a private university, and there are many other schools of different kinds, all of which supplement the Government institutions. Even in the technical and professional establishments, however, attention is not confined to the subjects required for strictly utilitarian purposes or for examinations; the first object is to train *men* who will be able to serve their country, in the fullest sense of that term. Many discussions are now being carried on with regard to the future of education in Japan, and the general tendency of these was indicated a short time ago by a distinguished Japanese author when he said, "No system of education which is not based on sociological conditions can be thoroughly successful, and therefore a study of ethnology, sociology, and of evolution generally is absolutely essential to a thorough understanding of the educational questions awaiting solution." The Japanese are now face to face with many problems which confront all industrial nations, and it is to be hoped that, having organised their education generally, and in some respects given an example to western nations, they will go a step further and show that it is possible to combine industrial development with the welfare of all classes of the community.

The chief lessons which the British Science Guild has to learn from Japan is that if it is to be of any real influence in the life of the Empire, the term *science* must be used in its broad sense, as including all knowledge required for individual and collective life, and that all efforts must be guided by a consciousness of the real aims of national life.

Glasgow, December 6. HENRY DYER.

The Heating Effect of the γ Rays from Radium.

IN a recent communication to the *Physikalische Zeitschrift* (No. 18, September) Paschen has described some experiments which indicate that the γ rays from radium supply a large proportion of the total heat emission. It is known that the heating effect of radium when surrounded by an envelope of sufficient thickness to absorb both the α and β rays is about 100 gram calories per hour per gram. Paschen, however, found that if the radium was surrounded by a sufficient amount of lead to absorb completely the γ rays the heating effect was increased 2·26 times. This large heating effect of the γ rays was so unexpected, and of such great importance in connection with the nature of these rays, that we decided to verify this result by an independent method. In Paschen's experiments, the heating effect was determined in a special Bunsen ice calorimeter, in the central tube of which the radium, surrounded by a lead cylinder about 4 cm. in diameter, was placed. In order to correct for the natural melting of the ice mantle a differential method was employed. In our experiments we decided to use a differential air calorimeter, similar to the one described in our previous work on the heating effect of radium and its emanation (*Phil. Mag.*, February). In each flask of the differential air calorimeter

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there was placed a narrow glass tube, closed at the lower end and extending to about the centre of the flask. The radium bromide weighing 23·7 milligrams was enclosed in a small metal capsule supported by a thread, and was inserted alternately in the glass tubes. The flasks, originally at atmospheric pressure, were immersed in a water bath kept in a constant temperature room, and were connected by a xylene tube which served as a manometer. The heating effect was measured by the movement of the xylene column, observed by a telescope with micrometer eye-piece, and the scale was calibrated by a small heating coil of approximately the same dimensions as the radium. Two sets of experiments were carried out, in one of which the ends of the glass tubes were inserted in lead cylinders 3 cm in diameter and 3 cm. high, and in the other with aluminium cylinders of exactly the same dimensions.

The lead envelope absorbed more than half the γ rays, while the aluminium absorbed only a few per cent. The readings were found to be very steady and consistent, but no appreciable difference in heating effect could be detected in the two experiments. As a check, the heating coil was employed in both experiments to calibrate the readings, the means of which agreed to about 1 per cent.

According to Paschen's results, the heating with the lead cylinders should have been at least 50 per cent. greater than with the aluminium cylinders. In our experiments we could not have failed to detect a difference of 5 per cent. We conclude from this that the γ rays do not supply more than a small percentage of the total heating effect of radium.

E. RUTHERFORD.
H. T. BARNES.

McGill University, December 1

Singularities of Curves.

THE compound singularities of algebraic curves offer a wide field for discussion, but the naming of the simple singularities has not yet been placed on an entirely satisfactory footing. The latter consist of (1) point singularities, which are nodes and cusps; (2) line singularities, which I prefer to call bitangents and inflections. Mr. Basset calls them double and stationary tangents; but if this is done, symmetry requires that the point singularities should be called double points and stationary points, and this is not admissible, because the phrase double points (as now used) includes cusps as well as nodes. If a curve has a double point Mr. Basset calls it *autotomic* (self-cutting); but this term is incorrect when all the double points in the curve are cusps (as in the cardioid), for the curve does not then cut itself. If it is really desirable to have a means of distinguishing curves that have nodes or cusps from those that have none, they may perhaps best be described respectively as curves with or without point singularities.

December 8. T. B. S.

A CHRISTMAS BIRD-BOOK.[1]

THE success which attended his last children's bird-book has induced Mr. Kearton to cater once more for the wants of young people interested in the animal life around them, and the result is the present charming little volume, illustrated, as usual, by reproductions from photographs taken direct from nature by the author and his brother. In the guise of a narrative told by "Cock Robin" to his offspring, the author has contrived to convey in his own inimitable manner a vast store of information concerning bird-life, interspersed with observations relating to other animals. Although, as already said, intended primarily for juvenile readers, the volume contains a certain amount of information which may be new to some of their seniors, including those to whom natural history is not an unknown study. For instance, until we learnt it from Mr. Kearton's pictures, we ourselves were ignorant of the marked and easily recognised difference between the foot-prints of a rabbit and those of a hare, despite the number of times they have come under our notice in the snow.

Generally Mr. Kearton conveys his information in simple language, but he is very prone to speak of a bird picking up food between its two mandibles when it would be "shorter, simpler, and better understood" (to quote from a well known Bar story) if he said beak. Apparently old fables connected with animals die hard, for, according to the author, many young people at the present day believe that a wren is a female robin, and that male robins lose their red breasts in summer.

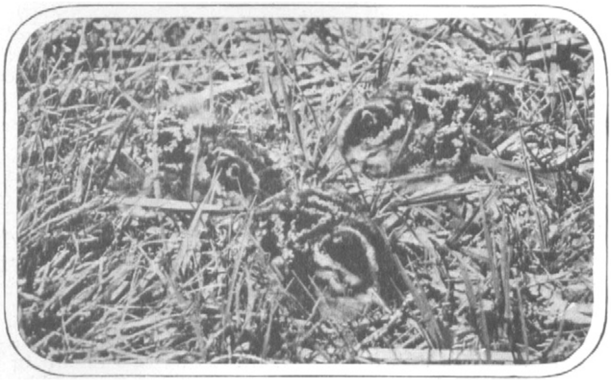

FIG. 1.—Young Dunlins in their natural surroundings. From Kearton's "Cock Robin." (Cassell and Co.).

These and other old wives' legends Mr. Kearton does his best to replace by accurate and interesting accounts of the mysteries of bird-life.

The best (if there can be a best where all is so interesting) of the five chapters are the two on nesting and the clamour of chicks, both being illustrated by a number of photographs of nests and young birds. Very graphically does the author bring out the remarkable difference in development at the date of hatching between a young sparrow, for instance, and that of a woodcock, and he also shows how much this difference depends on habit, a young skylark showing a somewhat intermediate stage. Very striking are the two photographs here reproduced, the one showing young dunlins skulking amid their native covert, and the other the same birds removed to an uncongenial environment.

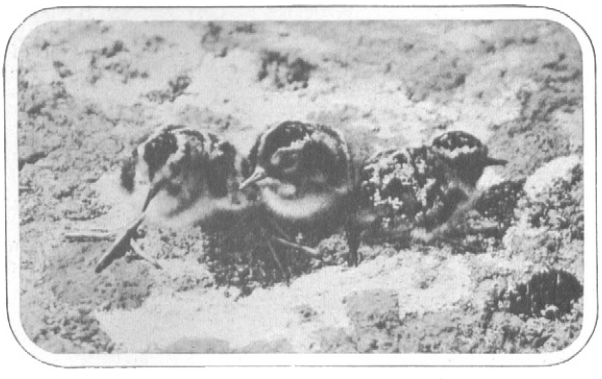

FIG. 2.—The same birds in unnatural surroundings. From Kearton's "Cock Robin." (Cassell and Co.)

"Nature-teaching" could not be conveyed in a better manner, or in one less free from affectation and faddism, and we trust that the "Kearton annual" will enjoy the extensive patronage that it certainly merits among those on the look-out for suitable Christmas presents for their young friends.

R. L.

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[1] "The Adventure of Cock Robin and his Mate." By R. Kearton. Pp. xvi+240; illustrated. (London: Cassell and Co., Ltd., 1904.) Price 6s.

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